GO solar CALIFORNIA

CSI RD&D PROGRAM

Improved Technology

Grantee:
Amonix

Partners:
University of California Irvine Advanced Power and Energy Program, National Renewable Energy Laboratory, Department of Energy, Southern California Edison

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Match Funding:
$988,366

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RD&D Project Portal:
calsolarresearch.ca.gov/csi/71

Itron | CSI RD&D PROGRAM MANAGER

Improved Cost, Reliability, and Grid Integration of High Concentration PV Systems

OVERVIEW AND OBJECTIVES

Concentrating photovoltaic systems (CPV) represent a very small portion of the total solar market due to long-term reliability and performance uncertainty, high cost and potential issues with integrating this technology into the electricity grid. Amonix has developed a high-concentration photovoltaic (HCPV) system that uses lenses to focus 500-times incident sunlight onto small, highly efficient PV cells. An emerging technology in solar markets, CPV is well-suited for large multi-megawatt solar projects. The purpose of this research project was to install and monitor the performance of CPV units and the associated circuits within the University of California, Irvine (UCI) electric infrastructure and to evaluate and compare grid interconnection and energy management strategies.

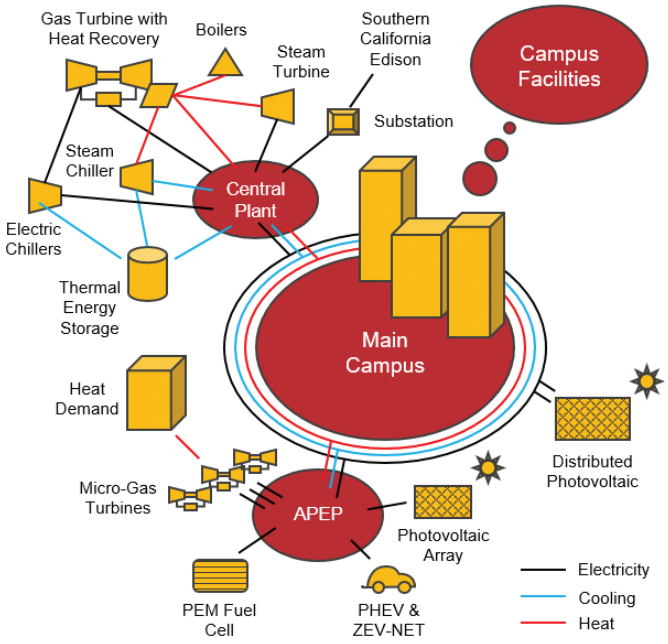
Amonix installed two of its 7700 CPV systems (53 kW each) on the UCI campus for studies of grid integration by UCI and joint studies of CPV reliability with the National Renewable Energy Laboratory (NREL). As part of this deployment, the UCI Advanced Power and Energy Program (APEP) identified and documented the challenges and opportunities for installing large CPV systems on UCI's distribution circuits. NREL looked at how to correlate measured weather data with accelerated testing in order to predict lifetime and reliability validation that will help to secure financial investments for future HCPV system deployment. The NREL model provides project owners and the financial community with data on system reliability and lifetime performance, supporting the acceleration and adoption of HCPV technology on a much wider scale. This project is complementary to UC Irvine's Renewable Energy Secure Communities (RESCO) project that received grant funding from the California Energy Commission, in part, for renewable generation deployment on the campus.

This document provides a brief project description. For more detail on the project and the California Solar Initiative's (CSI) Research Development, Demonstration & Deployment (RD&D) Program, please visit calsolarresearch.ca.gov

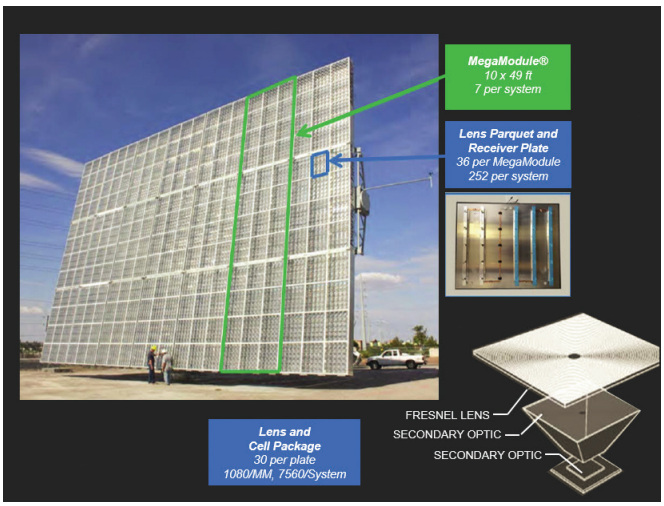
The CSI RD&D Program is managed by Itron on behalf of the California Public Utilities Commission (CPUC).

METHODOLOGY

The two Amonix systems were equipped with independent high-resolution power meters that collected voltage, current, real and reactive power, frequency, phase, and harmonic distortion measurements at a one-minute sampling rate. Current meters monitored the outputs of individual solar panel strings. An onsite meteorological weather station recorded wind speed, temperature, and insolation measurements. The data were collected by Amonix and then mirrored onto a FTP server for access by APEP researchers. NREL conducted accelerated testing and compiled field data to develop a method to evaluate the reliability and lifetime of CPV technologies. Lifetime and reliability validation will be essential to secure major investment and financing of future CPV system deployment. The NREL team conducted Highly-Accelerated Lifetime Tests (HALT) and correlated field data with HALT, developed a thermal fatigue model as well as a lifetime test protocol.



Electrical Infrastructure at UC Irvine



Amonix 7700 High-Concentration PV System

RESULTS AND OUTCOMES

Outcomes of this research include the manufacturing of two CPV systems and the installation of the systems on UCI's distribution grid where they have operated successfully for over three years. UCI's APEP developed a central power plant and CPV dynamic models for system operation. Their models were used to investigate the CPV penetration limits on a campus circuit, and it was found that only when CPV capacity reached ten times the baseline-installed capacity (about 1,200 kW), did effects on the circuit become noticeable. UCI's APEP team also documented the interconnection and operation of CPV systems within the UCI energy system. NREL developed a thermal fatigue model to predict CPV solar cell lifetime. The model became the basis for an international CPV durability standard IEC 62925. This is the first international lifetime reliability standard for CPV. The research project identified no major barriers to CPV's distribution grid integration and no issues with the long-term reliability of CPV.

PUBLIC BENEFITS

- Experience that can inform and guide similar CPV projects in California.
- Models for CPV generation which enable an evaluation of the benefits and issues for CPV installations in other California distribution grids.
- One international CPV standard and eight conference presentations/proceedings.
- A durability standard that provides a lifetime protocol for testing CPV, which also benefits other PV technologies.
- A thermal fatigue model that is useful to conventional flat-panel PV technologies since they lack a lifetime prediction model.